Not to be cited without
permission of the authors[1]

Canadian Atlantic Fisheries
Scientific Advisory Committee

CAFSAC Research Document 85/82

Ne pas citer sans
autorisation des auteurs[1]

Comité scientifique consultatif des
pêches canadiennes dans l'Atlantique

CSCPCA Document de recherche 85/82

Assessment of the 4TVn (Jan-Apr) Cod Stock for 1985

by

G. A. Chouinard and D. Clay

Fisheries Research Branch
Department of Fisheries and Oceans
P.O. Box 5030
Moncton, NB
E1C 9B6

[1]This series documents the scientific basis for fisheries management advice in Atlantic Canada. As such, it addresses the issues of the day in the time frames required and the Research Documents it contains are not intended as definitive statements on the subjects addressed but rather as progress reports on ongoing investigations.

Research Documents are produced in the official language in which they are provided to the Secretariat by the author.

[1]Cette série documente les bases scientifiques des conseils de gestion des pêches sur la côte atlantique du Canada. Comme telle, elle couvre les problèmes actuels selon les échéanciers voulus et les Documents de recherche qu'elle contient ne doivent pas être considérés comme des énoncés finals sur les sujets traités mais plutôt comme des rapports d'étape sur les études en cours.

Les Documents de recherche sont publiés dans la langue officielle utilisée par les auteurs dans le manuscrit envoyé au secrétariat.

ABSTRACT

The cod fishery in NAFO Division 4T and Sub-division 4Vn (Jan-Apr) resulted in a provisional nominal catch of 56,974 t in 1984, 5,177 t less than in 1983 and over 10,000 tons short of the TAC. Sampling of landings in 1984 was the most extensive to date with 67,725 fish measured and 11,764 otoliths taken. As in 1983, the 1977 year class was dominant in the catch with 26.7% of the numbers landed. The standardized catch rate for 1984 is down from 1983 from 0.769 t/h to 0.665 t/h, a level comparable to 1980-1981. Population numbers estimated from the E.E. Prince fall groundfish survey indicate stable numbers for the period 1982-1984. The 1980 year class was noticed as very strong in previous years and is still the dominant year class in the population. Full recruitment is only attained at age 8. SPA calibrated with the standardized catch rates and research vessel population number estimates resulted in F_t = 0.30. If the 1985 TAC of 67,000 t is caught then the 1986 catch at $F_{0.1}$ = 0.2 would be 59,813 t.

RESUME

La pêche à la morue dans la Division 4T-Vn (Jan-Avr) de l'OPANO a donné lieu à des prises nominales préliminaires de 56 974 t en 1984. Ceci constitue 5 177 t de moins qu'en 1983 et environs 10 000 t de moins que le TPA. L'échantillonnage des prises commerciales en 1984 a été le plus important à date; 67 725 poissons ont été mesurés et 11 764 paires d'otolithes prélevées. Comme en 1983, la classe d'âge de 1977 était dominante dans les prises constituant 26,7% des individus capturés. Le taux de capture standardisé a diminué de 0,769 t/h en 1983 à 0,655 t/h en 1984; un niveau semblable aux années 1980-1981. Les effectifs estimés par la croisière d'automne de poissons de fonds du E.E. Prince sont demeurés stable dans la période 1982-1984. La classe d'âge de 1980 considérée comme importante lors des évaluations précédentes est devenu la classe d'âge la plus importante de la population. Les individus sont pleinement recrutés à l'âge de 8 ans. L'ASP calibrée avec les taux de captures standardizés et les effectifs estimés par la croisière de recherche a resulté en un F_t optimal de 0,30. Si le TPA de 67 000 t pour 1985 est capturé alors la prise à $F_{0,1}$ = 0,2 pour 1986 sera de 59 813 t.

INTRODUCTION

Over the last decade, the cod fishery in NAFO Division 4T and Sub-division 4Vn (Jan-Apr) has resulted in catches ranging from a low of 22,219 t in 1977 to a high of 65,177 t in 1981. Since 1981, nominal catches have fluctuated around a mean of 60,000 t.

Because of its migration, the 4TVn cod stock supports two distinct fisheries. The winter fishery is conducted in the Sydney Bight area (NAFO Subdivision 4Vn) while the summer fishery (Apr-Dec) is carried out in the southern Gulf of St. Lawrence (NAFO Division 4T) during the ice free period.

During 1984, the established fishing pattern did not change significantly from previous years. The mobile gears (otter trawls, Danish and Scottish seines) accounted for approximately 75% of the total catch as in the previousfour years (Figure 1). The catch by miscellaneous and unknown gears is down to approximately 2% of the total catch compared to the 10 to 12% in previous years. However, this reduction is the result of better reporting of

catch statistics from Quebec and not a change in the fishery. For the same reasons, the percentage of the catch caught by fixed gear (especially gillnets) is higher.

The catch by month (Figure 2) followed the same general trend as in previous years with the highest monthly catch in the winter and summer fisheries being January and May respectively. The French fleet caught their 4Vn allocation of 7,000 t in only 330 days on ground compared to the usual 600 days (Stegen and van Helvoort, Unpublished Report, Dept. of Fisheries and Oceans, Fisheries Operations Branch, Halifax, NS 1984). Fishermen from the northeastern New Brunswick mobile fleet reported very poor catch rates from June to September. Catch rates returned to near normal levels in the last quarter as illustrated in Figure 2.

NOMINAL CATCHES

Historical catches and TACs for the period between 1950 and 1984 are presented in Table 1. The 1984 provisional catch is 56,974 t. This is 5,177 t less than the 1983 catch and over 10,000 t less than the established TAC of 67,000 t. It is slightly lower than the long-term (1950-1984) average catch of 57,627 t. Landings for NAFO Division 4T and Subdivision 4Vn were respectively 41,797 and 15,177 t. The proportion of the total 4TVn catch from 4Vn increased from 22.4% in 1983 to 26.6% in 1984, a level comparable to 1981 and 1982. Breakdowns for 1984 by country, gear and month are presented in Tables 2 and 3.

ASSESSMENT NOTES

The 1983 4TVn cod catch was revised downwards from the provisional catch of 66,891 t reported in 1984 to 62,151 t. (see final catch by country, gear and month; Appendix I and II). As a consequence, the 1983 catch at age and weights at age were recalculated using the revised catches and the same methods used in Lever and Waite (1984). The age-length keys used, to derive the catch at age and weights at age numbers are shown in Appendices III, IV and V

The numbers at age and average number per tow calculated for the E.E. Prince research survey are provisional.

CATCH AT AGE AND WEIGHTS AT AGE

Sampling of the 4TVn cod fishery in 1984 was the most extensive to date with 302 samples collected with a total of 67,725 fish measured and 11,764 otoliths taken for age determination. Details of the sampling program by month and gear are presented in Table 4. Fourteen age-length keys (Table 5) produced by the computer program ALSYSX were used to derive the catch at age for 1984 (Table 6). Closer examination of catch at age for individual keys for 1983 (Appendix IV) and 1984 (Table 6) revealed that the age composition for otter trawlers in 4Vn (Age-key #1 in both tables) was similar to the key for 4T in the second quarter (Age-key #2 in both tables). Slightly more younger fish were landed in 4Vn compared to 4T in 1984.

As in 1983, the 1977 year class was dominant in the 1984 age composition with 26.7% of the numbers landed. The 1980 year class which was strongly represented in the catch in 1983 as 3 years old was only moderately represented in 1984 with 10.3% of the numbers landed.

The catch-at-age matrix for the period 1971 to 1984 is shown in Table 7. The following length-weight relationship derived from the 1984 E.E. Prince fall groundfish survey was used in the analyses:

$$Wt_{kg} = 0.0041762 \, L_{cm}^{3.1880811}$$

The corresponding weights at age for each key are presented in Table 8. The weights at age for cod caught by gillnets are markedly higher than for the other sectors of the fishery (Table 8, age-key #8 and 9). Similar results are observed for the 1983 weights at age (Appendix V, age-key #8). This is likely due to the different mesh selectivities of gillnets (140 mm) and otter trawls (130 mm). Gillnets tend to select larger and heavier fish.

As in the previous assessment (Lever and Waite, 1984), the average weights at age for the year were estimated using:

$$\frac{\sum_i \frac{CW_i \times W_{i,j}}{W_i}}{\sum_i \frac{CW_i}{W_i}}$$

where CW = catch weight

W = average weight

i = key index

j = age index

The resulting weights were considered mid-year weights as most of the fishery occurs in the summer. The weights at age obtained for 1984 are slightly higher than in 1983 for most of the ages (Table 9).

CATCH PER UNIT OF EFFORT

The commercial catch per unit of effort index for the 4TVn cod fishery was derived using the multiplicative model (Gavaris, 1980). Data for otter trawlers, Danish and Scottish seiners and longliners were standardized for the years 1966 to 1984 using hours fished as the effort.

The number of hours fished reported for Quebec vessels was considered inacurate. However this effort could not be omitted as examination of the 1983 data showed that exclusion of Quebec data produced an overestimation of CPUE. Effort in hours for the Quebec fleet for 1984 was therefore obtained by multiplying the number of days fished by the 1983 average number of hours fished per day on a monthly basis. A comparison of the average number of hours fished per day for 1980 to 1983 (Table 10) shows little year to year change. Results of the multiplicative model analysis are shown in Table 11 and Figure 3. The standardized catch rate for 1984 is down from 1983 from 0.769 t/h to 0.665 t/h, a level comparable to 1980-1981. These results confirm fishermen's comments which indicated that the catch rates were lower in 1984.

RESEARCH VESSEL SURVEY

Population numbers estimated from the E.E. Prince fall groundfish survey indicate stable numbers in the population for the period 1982-1984 (Table 12). The 1980 year class which was noticed as very strong in 1981, 1982 and 1983 is the dominant year class in the population. Mean numbers per tow by strata are shown in Table 13.

SURVIVOR

Analyses of "SURVIVOR" (Rivard 1982) indicated a terminal fishing mortality (F_t) between 0.2 and 0.3. The results were variable depending on the calibration block chosen indicating that the slope of the line differed with the period chosen and making the analysis unreliable. For this reason, the analysis was rejected and the results not utilized in this assessment.

SEQUENTIAL POPULATION ANALYSIS

The natural mortality was assumed to be 0.2. THe virtual population analysis (VPA) was calibrated using terminal fishing mortalities for 1984 between 0.200 and 0.500.

Partial recruitment (PR) was estimated using the ratio-normalized on fully-recruited age classes (RNF) method as described by Rivard (1984). The RNF method was first applied to the 1982, 1983 and 1984 data using the average of fully recruited 9, 10 and 11 years old for normalization. For each age, PR was averaged over the 3 years and then normalized to the first value above 1.0. Only 1982 to 1984 were used in this calculation because there was a cod-end mesh size regulation increase from 120 mm to 130 mm. The resulting vector is flat-topped with full recruitment at age 8.

AGE	3	4	5	6	7	8	9
PR	0.018	0.132	0.313	0.619	0.845	1.000	1.000

The calibration of 5+ biomass versus catch rate indicated a terminal fishing mortality (F) 0.325 as did the calibration of 6+ biomass versus catch rate. The calibration of 4+ research vessel numbers versus 4+ population numbers indicated a F_t of 0.300 (Table 14). Based on these results an F_t of 0.300 was considered appropriate for 1984.

The partial recruitment as calculated above was considered too high for younger ages in 1984, especially considering the mesh size increase in 1981. Therefore, the average partial recruitment for the years 1981-1983 (below) was used to estimate population numbers and biomass and fishing mortalities (Table 15, 16 and 17).

AGE	3	4	5	6	7	8	9
PR	0.003	0.048	0.208	0.463	0.674	1.000	1.000

The results indicate a 5% population biomass increase from 1983 to 1984. he 1980 year class is dominant in the population accounting for almost 50% of the population in numbers, and this year class is the largest observed in the period 1971-1984.

PROJECTIONS

A regression of age 3 population numbers (lagged one year) against age 2 research survey numbers indicated a good relationship ($r^2 = 0.85$) and predicted a 1984 recruitment of 200 million fish. The recruitment for 1985 was estimated using the geometric mean of age 3 for the period 1971-1983 and resulted in 101 million fish. The average of the 1982 to 1984 weights at age was used for the projections. The input parameters used are shown in Table 18 and the results in Table 19. Using these parameters, if the 1985 TAC of 67,000 t is caught then the 1986 catch at an $F_{0.1}$ of 0.2 would be 59813 t. Considering the low level of catches relative to the TAC in 1984, if the stock is fished at $F_{0.1}$ in 1985 then the $F_{0.1}$ catch for 1986 would be 64,303 t.

ACKNOWLEDGEMENTS

Special thanks to S. Chiasson and M. Poirier for their assistance in the preparation of tables and data entry. The authors would also like to thank the professionnal staff of the Marine Finfish Section, Moncton for their comments and their helpful suggestions.

REFERENCES

Gavaris, S. 1980. Use of the multiplicative model to estimate catch rate and effort from commercial data. Can. J. Fish. Aquat. Sci., 37(12): 2272-2275.

Lett, P.F. 1978. A multispecies simulation for the management of the southern Gulf of St. Lawrence cod stock. CAFSAC Res. Doc. 78/21.

Lever, D. and L. Waite. 1984. Assessment of cod in NAFO Division 4T and Subdivision 4Vn (Jan-Apr) for 1984. CAFSAC Res. Doc. 84/52.

Rivard, D. 1982. APL programs for stock assessment (Revised) Can. Tech. Rep. Fish. Aquat. Sci. No. 1091: 144 p.

Rivard, D. 1984. Estimating partial recruitment from catches and a research survey index: a Monte-Carlo simulation. CAFSAC Res. Doc. 84/70.

Table 1: Nominal 4TVn (Jan.-Apr.) cod catch and TAC for 1950 to 1984. (Sources: a. 1950-1964 from Lett, 1978; b. 1965-1983 from NAFO statistics; c. 1984 provisional from Department of Fisheries & Oceans, Statistic Branches).

YEAR	NOMINAL CATCH	TAC	YEAR	NOMINAL CATCH	TAC
1950	44023a	-	1970	64465	-
51	34827	-	71	56375	-
52	41956	-	72	65291	-
53	58911	-	73	50635	-
54	63901	-	74	48747	63000
1955	65227	-	1975	42471	50000
56	104469	-	76	33415	30000
57	89131	-	77	22219	15000
58	86582	-	78	37892	38000
59	70720	-	79	55996	46000
1960	66013	-	1980	54634	54000
61	65583	-	81	65177	53000
62	66664	-	82	58193	60000
63	70202	-	83	62151	62000
64	60547	-	84	56974c	67000
1965	63027b	-			
66	54851	-			
67	41316	-			
68	46551	-			
69	47819	-			

Table 2: Provisional 4T cod catches (t round weight) during 1984 by gear type and month in Maritime Provinces, Newfoundland and Quebec.

GEAR	J	F	M	A	M	J	J	A	S	O	N	D	TOTAL	% OF 4TVn (Jan-Apr) CATCH
MARITIME PROVINCES														
Otter trawl (side)	1077		18	158	955	277	99	61	13	50	108	6	2822	4.95
Otter trawl (stern)	783	105	44	180	1103	271	165	146	65	235	512	950	4559	8.00
Midwater trawl (side)					4	9	4						17	0.03
Danish seine				1396	3747	875	481	392	259	671	1406	1518	10545	18.51
Scottish seine				414	785	98			2	3	43	22	1367	2.40
Purse seine											3		3	0.01
Gillnets (fixed)	2	5		85	282	333	883	881	550	363	236	21	3641	6.39
Longline	2			6	21	60	48	65	43	184	556	347	1332	2.34
Handline					28	108	241	100	55	70	48		648	1.14
Traps					11	17	7	6	2	12			55	0.10
Dredge								1	2	4			7	0.01
Miscellaneous						3		3	1	4	2		13	0.02
TOTAL	1864	110	62	2239	6936	2051	1928	1655	990	1596	2914	2864	25009	43.90
NEWFOUNDLAND														
Otter trawl (side)					30								30	0.05
Otter trawl (stern)	607		43	81			40		1	33	4		809	1.42
Shrimp trawl												1	1	.00
Gillnets							4	11	12	6			33	0.06
Longline						1	41	2	6	31			81	0.14
Handline							2	5	13	1	1		22	0.04
Traps							25						25	0.04
TOTAL	607	0	43	81	30	1	112	18	32	71	5	1	1001	1.76
QUEBEC														
Otter trawl (side)					2229	960	689	528	526	1131	181		6244	10.96
Otter trawl (stern)					323	265	229	355	269	351	100	16	1908	3.35
Shrimp trawl					2	3	12	3	21	44	4		88	0.15
Danish seine						15	6	6	10				37	0.06
Scottish seine									2	3			5	0.01
Gillnet (fixed)				23	802	909	616	565	265	79			3259	5.72
Gillnet (drift)				1	2	3	2	22	19				49	0.09
Longline				1	271	181	589	469	337	335	47		2230	3.91
Handline				3	23	197	254	400	271	190	19	1	1358	2.38
Traps					2	2		3					7	0.01
Dredge								1					1	.00
Miscellaneous					73	206	263	26	30	3			601	1.05
TOTAL	0	0	0	28	3727	2741	2660	2378	1749	2136	351	17	15787	27.71
TOTAL 4T	2471	110	105	2348	10693	4793	4700	4051	2771	3803	3270	2882	41797	73.36

Table 3: Provisional 4Vn (Jan.-Apr.) cod catches (t round weight) during 1984 by gear type and month in Maritime Provinces, Newfoundland and France.

GEAR	J	F	M	A	TOTAL	% OF 4TVn (Jan-Apr) CATCH
			MARITIME PROVINCES			
Otter trawl (side)	1708	1478	473	243	3902	6.85
Otter trawl (stern)	1144	626	387	434	2591	4.55
Bottom pair trawl	9				9	0.02
Danish seine				8	8	0.01
Scottish seine				48	48	0.08
Longline	46		1	22	69	0.12
TOTAL	2907	2104	861	755	6627	11.63
			NEWFOUNDLAND			
Otter trawl (side)		175	351	320	846	1.48
Otter trawl (stern)	137			507	644	1.13
TOTAL	137	175	351	827	1490	2.62
			FRANCE			
Otter trawl (stern)	4727	1704	629		7060	12.39
TOTAL OF 4Vn	7771	3983	1841	1582	15177	26.64

Table 4: 4TVn cod commercial sampling in 1984 (number measured / number aged).

GEAR	J	F	M	A	M	J	J	A	S	O	N	D	TOTAL
Otter trawl	6476 / 714	2635 / 223	1897 / 171	2483 / 211	1951 / 482	2554 / 317	4024 / 540	2149 / 366	3867 / 243	2628 / 358	1034 / 12		31698 / 3637
Seines					2020 / 369	322 / 82	2257 / 411	1001 / 173	1464 / 208	1408 / 214	1918 / 360		10390 / 1817
Gillnet					179 / 76	2860 / 721	3181 / 877	2013 / 452	747 / 35	292 / 100			9272 / 2261
Longline	648 / 96				275 / 219	1251 / 333	2700 / 678	1541 / 199	1235 / 166	1023 / 232	1228 / 197		9901 / 2120
Handline					224 / 162		1801 / 591	925 / 449	3043 / 525	371 / 202			6364 / 1929
TOTAL	7124 / 810	2635 / 223	1897 / 171	2483 / 211	4649 / 1308	6987 / 1453	13963 / 3097	7629 / 1639	10356 / 1177	5722 / 1106	4180 / 569		67625 / 11764

Table 5: Age-length keys used in the calculation of the 1984 catch at age.

AGE-KEY NUMBER	FISHERY	SAMPLES	SAMPLES SIZE	CATCH
1	OTB JAN.-MAR.	L.F.: JAN.-MAR. OTB A.L.K.: JAN.-MAR. OTB	LENGTHS 11008 AGES 1108	16225
2	OTB APR.-JUNE	L.F.: APR.-JUNE OTB A.L.K.: APR.-JUNE OTB	LENGTHS 6988 AGES 1010	8349
3	OTB JULY-SEPT.	L.F.: JULY-SEPT. OTB A.L.K.: JULY-SEPT. OTB	LENGTHS 9774 AGES 1149	3190
4	OTB OCT.-DEC.	L.F.: OCT.-DEC. OTB A.L.K.: OCT.-DEC. OTB OCT.-DEC. SNU	LENGTHS 3928 AGES 944	3677
5	SNU APR.-JUN.	L.F.: APR.-JUNE SNU A.L.K.: APR.-JUNE SNU	LENGTHS 2342 AGES 451	7386
6	SNU JULY - SEPT	L.F.: JULY-SEPT. SNU A.L.K.: JULY-SEPT. SNU	LENGTHS 4722 AGES 792	1158
7	SNU OCT.-DEC.	L.F.: OCT.-DEC. SNU A.K.L.: OCT.-DEC. SNU	LENGTHS 3326 AGES 574	3466
8	GN JAN.-JUNE	L.F.: APR.-JUNE GN A.L.K.: APR.-JUNE GN	LENGTHS 3039 AGES 728	2447
9	GN JULY - DEC.	L.F.: JULY-DEC. GN A.L.K.: JULY-DEC. GN	LENGTHS 6233 AGES 1464	4535
10	LL JAN.-JUNE	L.F.: JAN.-JUNE LL A.L.K.: JAN.-JUNE LL	LENGTHS 2174 AGES 648	612
11	LL JULY -SEPT.	L.F.: JULY-SEPT. LL A.L.K.: JULY-SEPT. LL	LENGTHS 5476 AGES 1043	1600
12	LL OCT.-DEC.	L.F.: OCT.-DEC. LL	LENGTHS 2251 AGES 429	1500
13	LHP APR.-SEPT.	L.F.: APR.-SEPT. LHP A.L.K.: APR.-SEPT. LHP	LENGTHS 5993 AGES 1727	1698
14	LHP OCT.-DEC.	L.F.: SEPT.-OCT. LHP A.L.K.: SEPT.-OCT. LHP	LENGTHS 3414 AGES 727	330
	UNKNOWN, TRAPS, DREDGE & NON-SPECIFIED GEARS			701

Table 6: Catch at age for the 1984 age-length keys.

	AGE KEY NUMBER														SUB	UNSAMPLED	TOTAL
AGE	1	2	3	4	5	6	7	8	9	10	11	12	13	14	TOTAL	CATCH	
2	4			9											13	0	13
3	36	1	6	25		2	6				1	4	6	1	88	1	89
4	953	260	386	1138	362	57	319	4	28	3	28	140	140	31	3849	48	3897
5	1670	676	553	990	1136	177	547	20	90	13	62	209	199	42	6384	80	6464
6	1713	691	331	306	1431	156	343	119	179	26	72	154	253	30	5804	72	5876
7	3248	2135	683	503	1419	236	506	231	306	55	197	177	217	43	9956	124	10080
8	1966	869	197	159	421	94	216	134	212	35	109	66	90	16	4584	57	4641
9	1873	741	225	188	347	103	314	207	253	50	197	111	129	28	4766	59	4825
10	665	184	28	38	115	26	90	53	140	37	71	55	63	10	1575	20	1595
11	43	20	8	7	25	2	14	30	36	9	11	12	8	1	226	3	229
12	6	4	4		15			6	8	4	2		2		51	1	52
13	1		1		5			3	2		3		3		18	0	18
14								1	1	1	1				4	0	4
15	1							1	1	1					4	0	4
16								1	1		2	2			6	0	6
TOTAL	12179	5581	2422	3363	5276	853	2355	810	1257	234	756	930	1110	202	37328	466	37794

Table 7: Catch at age ('000) 1971-1984.

	YEAR													
AGE	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984
3	6	3177	1337	2731	1556	466	546	538	142	314	96	572	874	89
4	2040	22152	6888	4980	8781	3460	3357	9854	4959	2019	5762	1244	3878	3897
5	7082	11824	14327	4774	6761	8930	4115	10627	15531	15000	7277	10101	5725	6464
6	9018	6541	5242	9404	2487	6563	2865	4463	10956	14152	18841	9530	15009	5876
7	5746	7422	3648	2986	3237	1592	1686	2589	3391	9541	12863	12737	7439	10080
8	2276	3467	2736	1795	1293	1138	406	1065	1670	1274	6026	6690	8866	4641
9	1225	919	1803	1702	1104	446	291	237	835	699	867	2157	3370	4825
10	510	529	540	1035	791	265	180	241	291	320	432	526	760	1595
11	129	354	328	266	671	135	124	104	247	124	190	110	51	229
12	346	114	97	194	150	140	55	72	64	24	64	58	26	52
13	73	49	67	85	53	45	59	44	33	16	81	6	6	18
14	117	14	46	26	74	14	11	5	15	8	2	3	1	4
15	151	46	11	6	7	10	4	13	15	11	14	2	1	4
16	61	36	23	15	66	9	5	6	8	26	3	2	4	6
TOTAL	28780	56644	37093	29999	27031	23213	13704	29858	38157	43528	50518	43338	46010	37780

Table 8: Average weight at age for 1984 age length keys.

	AGE KEY NUMBER													
AGE	1	2	3	4	5	6	7	8	9	10	11	12	13	14
2	0.36	-	-	0.15	-	-	-	-	-	-	-	-	-	-
3	0.95	0.42	1.01	0.57	-	0.65	0.53	0.32	-	-	0.55	0.39	0.84	0.56
4	0.84	0.92	0.90	0.78	0.79	0.81	0.95	1.36	1.9	1.45	1.04	0.77	0.87	0.95
5	0.94	1.11	1.06	0.92	0.98	1.09	1.08	2.03	2.24	1.19	1.38	1.27	1.18	1.16
6	1.32	1.41	1.33	1.35	1.26	1.35	1.68	2.44	2.77	1.79	1.72	1.56	1.69	1.68
7	1.33	1.44	1.41	1.46	1.50	1.35	1.53	2.41	3.09	2.05	1.82	1.73	1.85	1.78
8	1.42	1.61	1.68	1.64	1.72	1.49	1.73	3.07	3.95	2.70	2.01	2.17	2.15	2.11
9	1.61	1.88	1.78	1.88	2.46	1.78	1.93	3.16	3.86	2.90	2.28	2.14	2.14	2.21
10	1.88	2.31	2.38	2.08	2.77	1.86	2.21	4.06	4.54	3.20	2.87	2.57	2.52	2.27
11	3.38	4.15	2.62	2.46	3.43	2.48	2.68	5.35	7.25	3.84	3.65	2.34	3.10	2.68
12	4.54	3.59	3.71	5.91	3.37	4.88	8.36	8.47	9.80	6.16	7.63	-	4.28	5.88
13	14.78	-	14.25	-	5.53	10.37	-	7.25	11.24	10.07	11.60	-	6.04	9.32
14	-	-	-	-	-	14.43	-	5.66	9.65	3.33	12.24	10.91	-	-
15	5.91	-	13.07	-	-	5.27	-	8.63	15.07	18.23	9.93	-	-	-
16	-	-	-	4.14	9.01	19.83	4.14	11.95	14.94	-	9.44	14.50	-	-
AVERAGE WEIGHT	1.33	1.50	1.32	1.09	1.40	1.56	1.47	3.01	3.61	2.63	2.11	1.61	1.68	1.63

Table 9: Average weight at age (kilograms) in 4TVn (Jan.-Apr.) 1971 - 1984.

	YEAR													
AGE	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984
3	0.756	0.352	0.456	0.602	0.481	0.640	0.533	0.400	0.506	0.563	0.503	0.713	0.684	0.725
4	0.815	0.559	0.667	0.778	0.737	0.739	0.759	0.680	0.706	0.687	0.674	0.757	0.842	0.904
5	1.114	0.914	0.919	1.078	1.142	1.067	1.250	1.028	1.005	0.918	0.848	0.971	1.125	1.083
6	1.402	1.329	1.273	1.484	1.762	1.504	1.809	1.658	1.415	1.205	1.132	1.179	1.262	1.454
7	2.145	1.515	1.682	1.958	2.363	2.168	2.437	2.257	2.215	1.471	1.381	1.448	1.428	1.525
8	3.679	2.540	2.301	2.676	2.751	2.828	3.511	2.180	3.302	2.641	1.831	1.671	1.598	1.735
9	3.834	4.788	3.575	2.892	3.220	3.213	4.238	4.348	4.067	2.893	3.149	2.112	1.855	1.993
10	5.251	5.921	5.511	4.176	3.697	3.858	4.286	4.650	7.137	3.563	4.120	3.081	2.152	2.344
11	6.009	7.181	6.007	6.065	4.455	4.739	5.069	6.489	7.025	7.949	4.454	3.852	7.669	3.449
12	4.774	8.037	7.910	7.261	6.955	5.055	5.489	6.542	6.706	5.799	5.600	3.713	6.399	4.886
13	6.822	8.823	6.148	8.292	9.193	6.233	6.735	6.245	4.701	10.305	6.029	6.890	7.415	11.668
14	7.452	10.103	6.706	6.595	6.316	10.357	8.968	5.080	8.719	5.806	7.070	9.297	11.074	10.165
15	7.912	5.591	8.927	9.119	8.392	11.498	10.803	11.560	15.417	9.758	5.492	4.190	12.048	7.874
16	17.903	11.172	6.048	11.741	6.172	14.203	9.262	10.183	17.403	9.348	6.759	11.101	13.129	8.791

Table 10: Average number of hours fished per day on a monthly basis for Quebec vessels fishing in NAFO 4T 1980-1983.

YEAR	MONTH										
	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	AVERAGE (HOURS/DAYS)
80	14.3	12.1	15.8	14.1	15.2	15.2	12.3	11.0	12.4	-	13.8 (35385/2566)
81	-	14.1	16.3	16.1	15.6	13.8	16.6	12.4	13.1	-	15.1 (46739/3088)
82	-	18.1	15.8	13.9	14.0	14.7	12.4	13.5	12.3	14.0	13.8 (29299/2119)
83*	-	12.9	13.6	16.2	15.0	12.9	13.3	11.7	11.9	-	13.9 (23923/1715)
Mean 80-83	14.3	14.0	15.6	15.5	14.6	14.3	14.0	12.0	12.6	14.0	14.3 (135314/9484)

*used to convert days to hours in 1984.

Table 11: Results of the multiplicative model analysis for 1984.
The four category types are: 1. Country-Gear-Tonnage Class.
2. NAFO Divisions. 3. Months. 4. Years

Table continued on next page

REGRESSION OF MULTIPLICATIVE MODEL

MULTIPLE R..... 0.784
MULTIPLE R SQUARED..... 0.615

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DF	SUMS OF SQUARES	MEAN SQUARES	F-VALUE
INTERCEPT	1	1.322E3	1.322E3	
REGRESSION	39	7.001E2	1.795E1	62.167
TYPE 1	9	1.585E2	1.761E1	60.975
TYPE 2	1	1.033E1	1.033E1	35.785
TYPE 3	11	1.403E2	1.276E1	44.172
TYPE 4	18	1.308E2	7.266E0	25.162
RESIDUALS	1520	4.389E2	2.888E-1	
TOTAL	1560	2.461E3		

Table 11 (continued)

REGRESSION COEFFICIENTS

	VARIABLE		COEFFICIENT	STD. ERROR	NO. OBS.
	INTERCEPT		-1.160	0.115	1560
COUNTRY-	M.Q., OTB-1, TC3	1	0.472	0.057	226
	M.Q., OTB-1, TC4	2	1.166	0.066	162
	M.Q., OTB-2, TC3	3	0.655	0.062	159
	M.Q., OTB-2, TC4; N, OTB-1, TC4	4	1.031	0.064	212
	M.Q.N., OTB-2, TC5	5	1.307	0.068	171
GEAR -	M.Q., SDN, TC2	6	0.399	0.062	161
TONNAGE	M.Q., SDN, TC3	7	0.762	0.067	117
	M.Q., SSC, TC3	8	0.970	0.069	104
	M.Q., LLS, TC2	9	0.881	0.072	97
DIVISION	4Vn	10	-0.305	0.051	339
MONTHS	Feb.	11	0.160	0.069	106
		12	-0.382	0.075	82
		13	-0.598	0.060	197
		14	-0.863	0.070	166
		15	-1.057	0.074	143
		16	-1.175	0.079	115
		17	-1.315	0.080	105
		18	-1.285	0.080	109
		19	-1.177	0.078	119
		20	-0.970	0.073	148
	Dec.	21	-0.640	0.075	120
YEARS	1967	22	0.077	0.114	54
		23	0.338	0.113	54
		24	0.348	0.105	80
		25	0.211	0.106	75
		26	0.076	0.102	96
		27	0.173	0.102	92
		28	0.012	0.103	92
		29	-0.192	0.107	72
		30	-0.235	0.109	65
		31	-0.152	0.107	73
		32	0.270	0.114	54
		33	0.263	0.108	72
		34	0.563	0.101	109
		35	0.574	0.103	95
		36	0.635	0.102	104
		37	0.738	0.104	92
		38	0.757	0.102	102
	1984	39	0.611	0.099	139

Table 12: 4TVn cod population numbers estimates from E.F. Prince fall groundfish survey 1971-1984.

	YEAR													
AGE	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984 *
1	118	1522	146	174	1052	6117	1105	2489	336	1976	9709	5336	9609	2556
2	1149	4393	9522	4793	23809	15934	20630	6732	43878	9328	41508	68459	37234	20258
3	12508	8887	18795	19768	6814	63330	30614	34014	44532	64773	38524	51237	137302	49648
4	15131	25099	8727	14661	19095	16008	25812	27033	94435	48643	114900	37737	53328	129269
5	14335	9493	13775	5637	7450	10604	10103	17009	57619	84680	95211	76862	19325	60085
6	11228	8458	6554	6621	3231	4589	5358	6104	23494	41569	92909	37864	33723	18586
7	6979	6109	4613	2866	2573	1333	3056	3388	6135	14994	39094	28749	19272	23269
8	1727	3097	3528	2028	1873	878	1315	1329	2517	2494	21063	13641	15344	9285
9	354	638	2235	2343	1345	495	969	396	1258	1210	2841	1966	3869	10418
10	381	529	611	748	652	390	621	720	336	506	1162	627	1055	3010
11	218	295	145	400	690	423	503	574	371	122	513	244	477	703
12	127	191	461	192	364	108	404	211	615	24	209	88	129	70
13	633	208	439	700	261	191	614	412	0	73	502	210	56	77
1+	64888	68919	69551	60931	69209	120400	101104	100411	275526	270392	458145	323020	330723	327234
2+	64770	67397	69405	60757	68157	114283	99999	97922	275190	268416	448436	317684	321114	324678
3+	63621	63004	59883	55964	44348	98349	79369	91190	231312	259088	406928	249225	283880	304420
4+	51113	54117	41088	36196	37534	35019	48755	57176	186780	194315	368404	197988	146578	254772
5+	35982	29018	32361	21535	18439	19011	22943	30143	92345	145672	253504	160251	93250	125503
6+	21647	19525	18586	15898	10989	8407	12840	13134	34726	60992	158293	83389	73925	65418
7+	10419	11067	12032	9277	7758	3818	7482	7030	11232	19423	65384	45525	40202	46832

* Provisional (see text)

Table 13: Mean number per tow in E.E. Prince fall groundfish cruise.

	YEAR													
STRAT	71	72	73	74	75	76	77	78	79	80	81	82	83	84*
15	0	13	1	5	1	0	0	0	0	0	2	1	5	2
16	79	62	67	12	19	7	74	78	221	88	203	281	338	220
17	100	3	33	20	22	129	98	80	50	807	1430	113	638	991
18	121	66	185	25	29	70	117	71	146	67	16	87	365	181
19	62	57	41	271	5	207	121	417	708	207	161	115	290	82
20	22	61	114	118	21	89	112	174	105	22	92	16	219	64
21	45	85	62	25	57	9	60	140	162	43	296	120	-	54
22	113	148	113	71	140	438	50	267	506	230	744	90	223	191
23	29	21	25	7	5	20	40	124	146	233	279	164	142	116
24	14	18	6	11	12	17	32	1	199	166	526	903	161	172
25	7	1	0	1	21	1	1	0	0	4	1	0	0	0
26	16	57	9	22	1	4	6	19	83	76	260	174	321	193
27	39	10	4	8	1	3	26	21	42	63	33	377	173	9
28	3	78	63	12	35	97	23	1	482	81	357	365	347	312
29	11	22	69	53	73	27	101	22	115	119	200	119	200	145
31	34	5	17	39	23	31	99	66	112	144	121	157	173	111
32	14	130	9	0	91	0	0	5	13	2	1	2	0	29
33	6	5	1	26	25	16	70	18	41	1	60	41	14	45
34	4	38	3	3	10	7	10	11	53	58	93	64	143	174
35	10	17	14	25	100	214	16	9	11	214	38	4	127	334
36	19	4	3	6	3	6	4	4	20	77	57	52	24	169
37	1	7	4	0	18	71	3	3	24	58	31	128	58	49
38	31	55	3	32	1	12	13	29	132	141	107	39	134	44
39	0	24	2	20	1	0	6	60	4	0	49	5	10	2

*Provisional (see text)

Table 14: Calibration tests for the 1984 assessment.

	F	CORRELATION COEFFICIENT	INTERCEPT	1984 RESIDUAL
5+ BIOMASS VS CPUE	0.200	0.814	-121770	-139014
	0.250	0.845	-78576	-91272
	0.275	0.855	-62879	-73660
	0.300	0.860	-49805	-59001
	0.325	0.862	-38752	-46615
	0.350	0.861	-29283	-35994
	0.375	0.856	-21090	-26785
	0.400	0.849	-29348	-18747
	0.500	0.796	7527	5335
6+ BIOMASS VS CPUE	0.200	0.677	-77362	-113426
	0.250	0.694	-48233	-77323
	0.275	0.698	-37631	-64255
	0.300	0.699	-28814	-53309
	0.325	0.698	-21359	-44082
	0.350	0.694	-14974	-36180
	0.375	0.688	-9446	-29338
	0.400	0.680	-4615	-23559
	0.500	0.634	9841	-5469
4+ POPULATION NUMBERS VS 4+ RESEARCH NUMBERS	0.200	0.782	89756	-62047
	0.250	0.793	94462	-23651
	0.275	0.793	96172	-9692
	0.300	0.789	97596	1939
	0.325	0.782	98800	11777
	0.350	0.772	99832	20211
	0.375	0.759	100724	27523
	0.400	0.745	101505	33916
	0.500	0.677	103842	53099

Table 15: 4TVn cod population numbers with F_t=0.30

POPULATION NUMBERS IN THOUSANDS 4T-Vn (JAN-APR) COD

YEAR :	71	72	73	74	75	76	77	78	79	80	81	82	83	84
AGE :														
3 :	87613.	34057.	45609.	52140.	40258.	101444.	158628.	195047.	105529.	186836.	102070.	181333.	368206.	98244.
4 :	38718.	71720.	25019.	36134.	40224.	31556.	82634.	129381.	159205.	86271.	152685.	83401.	148127.	300672.
5 :	30665.	29859.	38845.	14298.	25098.	25036.	22717.	64625.	97039.	125869.	68810.	121611.	67225.	117774.
6 :	30523.	18740.	13865.	18972.	7426.	14476.	12497.	14896.	43343.	65465.	89535.	49777.	90457.	49876.
7 :	18667.	16897.	9481.	6658.	7145.	3851.	5990.	7656.	8190.	25642.	40871.	56359.	32179.	60547.
8 :	5812.	10128.	7201.	4497.	2783.	2959.	1729.	3390.	3947.	3673.	12450.	21924.	34692.	19658.
9 :	3231.	2722.	5184.	3446.	2075.	1124.	1404.	1030.	1821.	1739.	1865.	4816.	11947.	20438.
10 :	1632.	1549.	1404.	2629.	1303.	716.	521.	888.	647.	745.	790.	753.	2016.	6756.
11 :	537.	879.	794.	666.	1226.	365.	349.	266.	510.	270.	324.	269.	325.	970.
12 :	816.	323.	403.	356.	300.	407.	170.	174.	124.	197.	110.	96.	122.	220.
13 :	180.	359.	163.	242.	119.	118.	207.	96.	78.	45.	140.	33.	27.	76.
14 :	282.	82.	250.	73.	122.	50.	56.	117.	40.	35.	22.	45.	22.	17.
15 :	290.	127.	55.	163.	37.	34.	29.	36.	91.	19.	21.	16.	32.	17.
16 :	162.	103.	62.	35.	120.	24.	19.	20.	18.	61.	6.	5.	12.	25.
3+ :	219128.	187542.	148334.	140310.	128253.	182160.	286958.	417642.	420583.	496866.	469707.	520517.	755388.	675292.
4+ :	131515.	153485.	102725.	88170.	87995.	80716.	128330.	222595.	315054.	310030.	367637.	339184.	387182.	577048.
5+ :	92797.	81766.	77706.	52036.	47771.	49160.	45696.	93214.	155849.	223759.	214952.	255703.	239056.	276376.
6+ :	62132.	51907.	38861.	37737.	22674.	24124.	22979.	28589.	58809.	97890.	146142.	134092.	171830.	158602.

Table 16: 4IVn cod population biomass with F_t=0.30

> POPULATION BIOMASS IN TONS OF COD

YEAR :	71	72	73	74	75	76	77	78	79	80	81	82	83	84
AGE :														
3 :	66235.	11988.	20798.	31388.	19364.	64924.	84549.	78019.	53397.	105189.	51341.	129290.	251853.	71227.
4 :	31555.	40091.	16687.	28112.	29645.	23320.	62719.	87979.	112399.	59268.	102910.	63195.	124723.	271807.
5 :	34160.	27291.	35699.	15414.	20662.	26714.	28396.	66434.	97525.	115548.	58351.	118084.	75628.	127550.
6 :	42793.	24905.	17650.	28154.	13085.	21772.	22607.	24697.	61330.	78885.	101353.	58687.	114156.	72520.
7 :	40040.	25598.	15947.	13036.	16885.	8348.	14598.	17280.	18142.	37720.	56443.	81608.	45951.	92334.
8 :	21383.	25725.	16570.	12033.	7657.	8367.	6069.	9527.	13034.	9700.	22795.	36635.	55437.	34068.
9 :	12388.	13031.	10534.	9966.	6602.	3613.	5949.	4567.	7404.	5030.	5874.	10171.	21924.	40733.
10 :	8569.	9169.	7740.	10978.	4818.	2762.	2235.	4127.	4617.	2654.	3280.	2320.	4538.	15856.
11 :	3224.	6309.	4768.	4042.	5462.	1729.	1768.	1724.	3584.	2144.	1442.	1035.	2493.	3546.
12 :	3896.	2599.	5184.	2588.	2139.	2055.	976.	1141.	834.	1144.	616.	357.	779.	1076.
13 :	1229.	3165.	1000.	2010.	1095.	736.	1397.	601.	369.	462.	844.	229.	202.	890.
14 :	2104.	830.	1674.	483.	773.	520.	505.	593.	345.	201.	158.	396.	241.	172.
15 :	2296.	708.	488.	1486.	307.	396.	300.	419.	1405.	185.	74.	69.	307.	133.
16 :	2895.	1151.	378.	410.	790.	336.	170.	201.	313.	571.	39.	55.	154.	223.
3+ :	272770.	192561.	161115.	160100.	137365.	165592.	232254.	297309.	374697.	410700.	405520.	502134.	690267.	731916.
4+ :	206534.	180573.	140318.	120712.	118001.	100668.	147705.	219290.	321300.	315511.	354106.	372043.	446415.	660609.
5+ :	174979.	140481.	123630.	100599.	88356.	77348.	84986.	131311.	208901.	254243.	251277.	309848.	321692.	388802.
6+ :	140819.	113190.	87932.	85185.	59694.	50634.	56590.	64877.	111376.	138695.	192926.	191564.	246064.	261352.

Table 17 : 4TVn cod fishing mortalities with F_t=0.30

FISHING MORTALITY

YEAR :	71	72	73	74	75	76	77	78	79	80	81	82	83	84
AGE :														
3 :	0.000	0.108	0.032	0.059	0.043	0.005	0.003	0.003	0.001	0.001	0.001	0.002	0.002	0.000
4 :	0.059	0.413	0.359	0.164	0.274	0.129	0.045	0.007	0.035	0.026	0.027	0.016	0.029	0.014
5 :	0.292	0.567	0.517	0.455	0.350	0.495	0.222	0.199	0.194	0.141	0.124	0.096	0.098	0.062
6 :	0.391	0.481	0.534	0.776	0.457	0.682	0.290	0.398	0.325	0.271	0.263	0.236	0.201	0.139
7 :	0.411	0.653	0.546	0.672	0.682	0.601	0.369	0.462	0.602	0.523	0.425	0.285	0.293	0.202
8 :	0.559	0.470	0.537	0.573	0.706	0.546	0.298	0.422	0.620	0.478	0.750	0.407	0.329	0.300
9 :	0.535	0.462	0.479	0.772	0.864	0.568	0.258	0.285	0.694	0.579	0.707	0.671	0.370	0.300
10 :	0.419	0.468	0.545	0.563	1.073	0.519	0.475	0.354	0.675	0.633	0.888	0.640	0.532	0.300
11 :	0.306	0.580	0.601	0.573	0.904	0.519	0.493	0.559	0.750	0.696	1.013	0.593	0.189	0.300
12 :	0.622	0.408	0.307	0.896	0.758	0.473	0.414	0.600	0.821	0.144	0.998	1.060	0.267	0.300
13 :	0.585	0.163	0.598	0.484	0.665	0.540	0.374	0.690	0.616	0.496	0.990	0.221	0.276	0.300
14 :	0.603	0.207	0.226	0.492	1.067	0.365	0.242	0.048	0.536	0.292	0.104	0.080	0.051	0.300
15 :	0.835	0.507	0.250	0.041	0.236	0.383	0.168	0.499	0.200	0.997	1.251	0.145	0.054	0.300
16 :	0.532	0.482	0.516	0.634	0.824	0.537	0.336	0.405	0.663	0.625	0.847	0.579	0.469	0.300
MEAN :	0.439	0.432	0.432	0.511	0.636	0.454	0.285	0.358	0.481	0.422	0.599	0.359	0.225	0.223
MEAN/POP:	0.173	0.415	0.344	0.302	0.286	0.177	0.058	0.087	0.115	0.111	0.140	0.104	0.074	0.067

Table 18: Input parameters used for the 1986 catch projection.

Age	1984 Population numbers	1984 Catch numbers	1982-1984 Average weights	PR
3	200,000	89	0.707	0.003
4	300,672	3,897	0.834	0.048
5	117,774	6,464	1.060	0.208
6	49,876	5,876	1.298	0.463
7	60,547	10,080	1.467	0.674
8	19,658	4,641	1.667	1.000
9	20,438	4,825	1.980	1.000
10	6,756	1,595	2.526	1.000
11	970	229	4.990	1.000
12	220	52	5.000	1.000
13	76	18	8.658	1.000
14	17	4	10.179	1.000
15	17	4	8.037	1.000
16	25	6	11.007	1.000

Table 19: 4TVn cod projections assuming a 1985 catch of 67,000 t.

AGE	Catch Numbers ('000)		Population Numbers ('000)		Catch Biomass (t)		Population Biomass (t)		Fishing Mortality	
	85	86	85	86	85	86	85	86	85	86
3	75	49	101443	101443	53	34	71720	71720	0.000	0.000
4	1921	635	163599	82987	1602	530	136441	69211	0.013	0.009
5	12093	4385	242650	132208	12819	4648	257209	140141	0.056	0.041
6	9724	13861	90592	187751	12622	17992	117589	243701	0.126	0.092
7	5405	7029	35539	65405	7930	10312	52136	95949	0.183	0.135
8	8770	3863	40497	24229	14620	6440	67508	40390	0.272	0.200
9	2582	4029	11923	25269	5113	7978	23608	50032	0.272	0.200
10	2685	1186	12396	7440	6782	2997	31313	18793	0.272	0.200
11	887	1233	4098	7735	4428	6154	20448	38598	0.272	0.200
12	127	408	588	2557	637	2039	2942	12784	0.272	0.200
13	29	59	133	367	250	507	1155	3178	0.272	0.200
14	10	13	46	83	102	135	469	848	0.272	0.200
15	2	5	10	29	18	37	83	231	0.272	0.200
16	2	1	10	6	25	11	113	71	0.272	0.200
3+	44314	36756	703526	637510	67000	59813	782735	785647	0.202	0.149
4+	44239	36708	602083	536067	66947	59779	711014	713927		
5+	42318	36072	438484	453080	65345	59249	574573	644716		
6+	30225	31688	195834	320871	52526	54601	317364	504575		

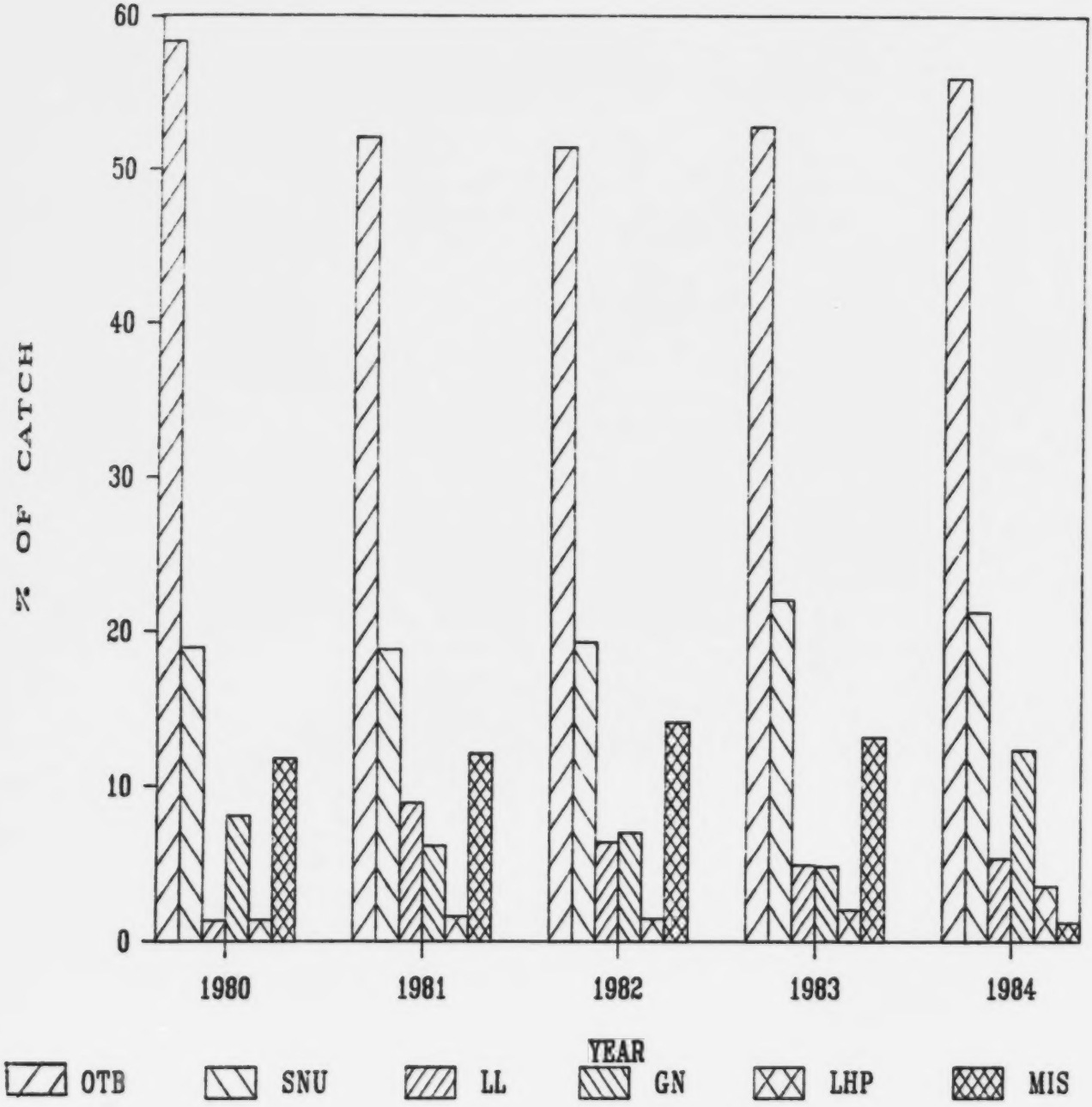


Figure 1: Percent of catch by gear 1980 - 1984.
(OTB: Otter trawl; SNU: Danish and Scottish Seines; Longlines; GN: Gillnets; LHP: Handlines; MIS: Miscellaneous and Unknown gear.)

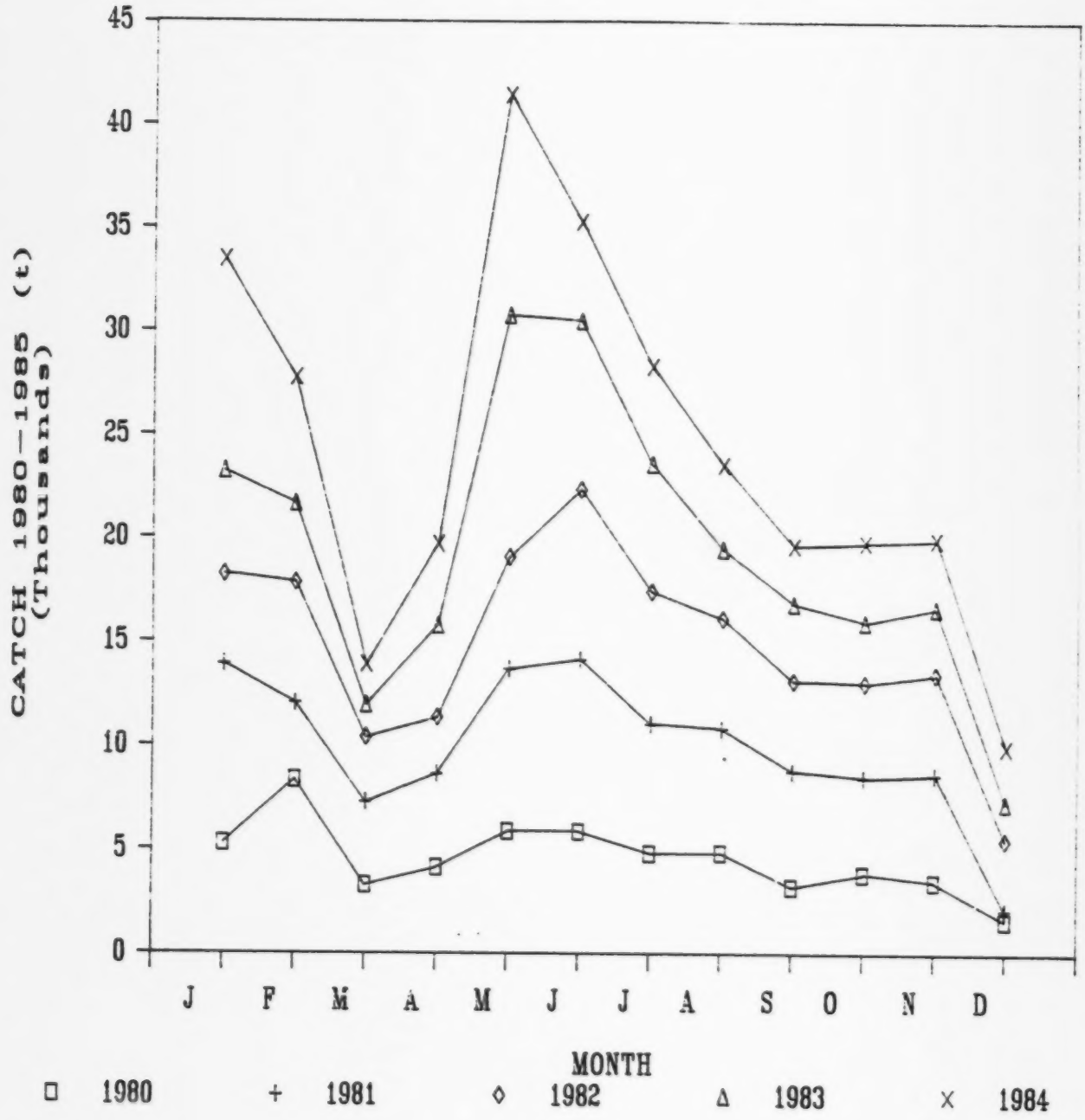
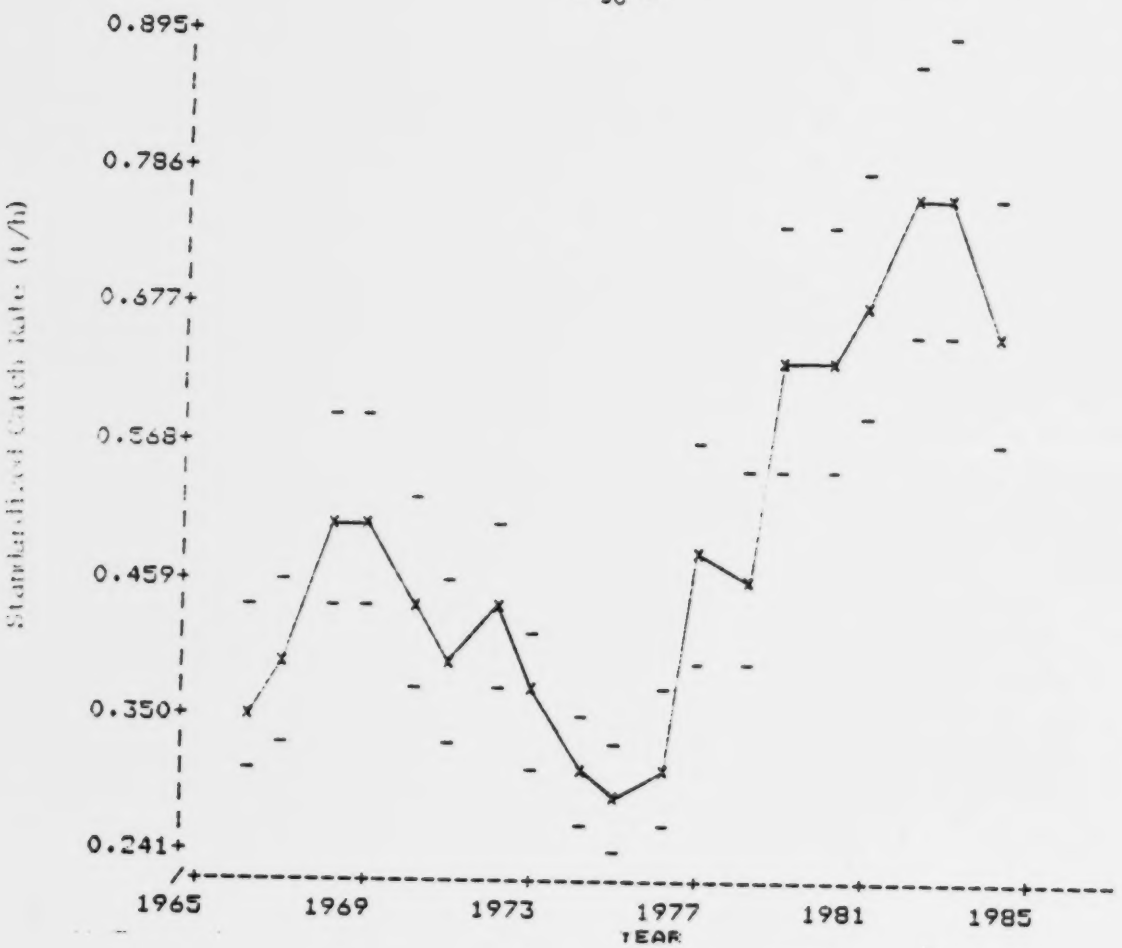


Figure 2: Cumulative cod catch by month 1980 - 1984



YEAR	LN TRANSFORM MEAN	LN TRANSFORM S.E.	RETRANSFORMED MEAN	RETRANSFORMED S.E.	CATCH	EFFORT
1966	-1.1600	0.0133	0.360	0.041	54851	152439
1967	-1.0831	0.0105	0.389	0.040	41316	106179
1968	-0.8222	0.0106	0.505	0.052	46551	92161
1969	-0.8115	0.0089	0.511	0.048	47819	93589
1970	-0.9491	0.0090	0.445	0.042	64465	144777
1971	-1.0839	0.0084	0.389	0.036	56375	144843
1972	-0.9871	0.0086	0.429	0.040	65291	152284
1973	-1.1479	0.0089	0.365	0.034	50635	138721
1974	-1.3516	0.0095	0.298	0.029	48747	163783
1975	-1.3954	0.0100	0.285	0.028	42471	149127
1976	-1.3115	0.0092	0.310	0.030	33415	107839
1977	-0.8898	0.0109	0.472	0.049	22219	47073
1978	-0.8967	0.0092	0.469	0.045	37892	80764
1979	-0.5968	0.0083	0.634	0.058	55996	88391
1980	-0.5858	0.0083	0.641	0.058	54634	85297
1981	-0.5251	0.0084	0.681	0.062	65177	95773
1982	-0.4221	0.0086	0.754	0.070	58193	77142
1983	-0.4029	0.0081	0.769	0.069	62151	80808
1984	-0.5486	0.0075	0.665	0.058	56974	85668

Figure 3: Predicted catch rates from the multiplicative model 1966-1984.

Appendix I: Final 4T cod catches during 1983 by gear type and month in Maritime Provinces, Newfoundland and Quebec.

GEAR	J	F	M	A	M	J	J	A	S	O	N	D	TOTAL	% OF 4TVn (Jan-Apr) CATCH
MARITIME PROVINCES														
Otter trawl (unsp.)					123	47	126	128	177	110	4		715	1.15
Otter trawl (side)	898	442	27	326	2783	579	243	119	91	219	467	356	6550	10.54
Otter trawl (stern)	490	1066	490	257	269	204	134	9	16	46	158	206	3345	5.38
Danish seine	14			2496	4378	1499	467	367	458	419	1368	849	12315	19.81
Scottish seine				140	244	225	85	23	17	40	75		845	1.36
Gillnet					140	443	753	637	529	207	56	11	2776	4.47
Longline				9	111	33	15	59	123	183	700	368	1601	2.58
Handline					23	261	312	204	258	184	28		1270	2.04
Pair Seine					239	136	17	22	5	2			421	0.68
Trap					1	35	6						42	0.07
Scallop					1								1	.00
Bottom pair trawl						2							2	.00
Miscellaneous					1	19	9	11	18	7			65	0.10
Unknown						7	1						8	0.01
TOTAL	1402	1508	517	3228	8313	3488	2168	1579	1692	1417	2854	1790	29956	48.20
NEWFOUNDLAND														
Otter trawl (stern)			448	7				57	48	142	225		927	1.46
Gillnet (set)								1					1	.00
Longline											9	9	18	0.03
TOTAL	0	0	448	7	0	0	0	58	48	142	234	9	926	1.49
QUEBEC														
Otter trawl (unsp.)				5		1	22	2		25	4		57	0.09
Otter trawl (side)				72	2016	1966	1492	268	968	796	49		7617	12.26
Otter trawl (stern)					95	62	51	22	41				251	0.40
Gillnet					34	25	49	66	48	11			233	0.37
Longline					92	265	515	212	152	57			1091	1.76
Miscellaneous			21	27	1124	2359	2103	1170	779	479	45		8087	13.01
TOTAL	0	0	21	104	3351	4658	4010	1740	1988	1366	98		17536	27.89
TOTAL 4T	1402	1508	986	3339	11664	8146	6178	3357	3728	2925	3186	1799	48218	77.58

Appendix II: Final 4Vn cod catches during 1984 by gear type and month in Maritime Provinces, Newfoundland and France

GEAR	J	F	M	A	TOTAL	% OF 4TVn (Jan-Apr) CATCH
			MARITIME PROVINCES			
Otter trawl (unsp.)	4	15		13	32	0.05
Otter trawl (side)	1403	1186	269	57	2915	4.69
Otter trawl (stern)	1432	724	224	467	2847	4.58
Longline	58	7		294	359	0.58
Danish seine	16	4		151	171	0.28
Scottish seine				11	11	0.02
TOTAL	2913	1936	493	993	6335	10.19
			NEWFOUNDLAND			
Otter trawl (stern)	700	353	100	84	1237	1.99
Longline		1			1	.00
TOTAL	700	354	100	84	1238	1.99
			FRANCE			
Otter trawl (stern)	1975	4365	20		6360	10.23
TOTAL	1975	4365	20		6360	10.23
TOTAL OF 4Vn (Jan.Apr.)	5588	6655	613	1077	13933	22.42

Appendix III: Age-length keys used in the recalculation of 1983 catch at age.

AGE-KEY NUMBER	FISHERY	SAMPLES	SAMPLES SIZE	CATCH
1	OT-4TVn JAN.-MAR. SNU-4Vn JAN.-FEB.	L.F.: JAN.-MAR. OT A.L.K.: JAN.-MAR. OT	LENGTHS 9178 AGES 1040	16631 34
2	OT-4TVn APR.-JUNE ST-4TVn JUNE	L.F.: APR.-JUNE OT A.L.K.: APR.-JUNE OT	LENGTHS 2417 AGES 446	9423 2
3	OT-4TVn JULY-SEPT	L.F.: JULY-SEPT. OT A.L.K.: JULY-SEPT. OT	LENGTHS 1441 AGES 444	3974
4	OT-4TVn OCT.-DEC.	L.F.: OCT. OT A.L.K.: AUG.-OCT. OT	LENGTHS 1919 AGES 527	2805
5	SNU-4TVn APR.-JUNE	L.F.: APR.-JUNE SNU A.L.K.: APR.-JUNE SNU	LENGTHS 3473 AGES 552	9142
6	SNU-4TVn JULY-SEPT	L.F.: JULY-SEPT. SNU A.L.K.: JULY-SEPT. SNU	LENGTHS 2916 AGES 416	1417
7	SNU-4TVn OCT.-DEC.	L.F.: OCT.-DEC. SNU A.L.K.: AUG.-DEC. SNU	LENGTHS 1390 AGES 427	2749
8	GN-4TVn MAY-DEC.	L.F.: JUNE-NOV. GN A.L.K.: JUNE-NOV. GN	LENGTHS 2035 AGES 463	3010
9	LL-4TVn JAN.-SEPT.	L.F.: JULY-SEPT. LL A.L.K.: JULY-NOV. LL	LENGTHS 282 AGES 587	1744
10	LL-4TVn OCT.-DEC.	L.F.: OCT.-DEC. LL A.L.K.: OCT.-DEC. LL	LENGTHS 3942 AGES 582	1326
11	LHP-4TVn MAY-NOV.	L.F.: JUNE-OCT. LHP A.L.K.: JUNE-OCT. LHP	LENGTHS 2003 AGES 610	1270
12	PTB-4TVn MAY-OCT.	L.F.: JUNE-JULY PTB A.L.K.: JUNE-JULY PTB A.L.K.: JUNE-JULY SNU	LENGTHS 493 AGES 49 AGES 382	421
	UNKNOWN & MISCELLANEOUS GEARS			8203

Appendix IV: Cod catch at age by age length key for 1983.

	AGE KEY NUMBER												SUB	UNSAMPLED	
AGE	1	2	3	4	5	6	7	8	9	10	11	12	TOTAL	CATCH	TOTAL
2				4		1	3						8	1	9
3	7		236	240	27	31	109	22	42	21	22	2	759	115	874
4	408	368	472	403	483	203	522	86	145	76	178	22	3366	512	3878
5	1169	927	338	325	892	228	442	158	184	104	152	50	4969	756	5725
6	3937	2619	1032	779	2662	291	623	305	224	142	241	113	13028	1981	15009
7	2318	1116	426	267	1192	206	326	198	165	87	112	44	6457	982	7439
8	2780	1810	454	238	1232	103	242	433	138	99	112	55	7696	1170	8866
9	840	527	103	39	797	53	111	156	118	97	50	34	2925	445	3370
10	316	178	6	3	74	16	8	9	16	22	6	6	660	100	760
11	11	0	0		12	1		5	5	9	1		44	7	51
12	8	1	0		5			3	2	4			23	3	26
13	3	2	0							0			5	1	6
14	0		0							1			1	0	1
15	0		0							1			1	0	1
16	0		1							2			3	0	3
17	1												1	0	1
TOTAL	11858	7548	3068	2298	7376	1133	2386	1375	1039	665	874	326	39946	6074	46020

Appendix V: Average weights for the age-length keys in 1983.

AGE	AGE KEY NUMBER 1	2	3	4	5	6	7	8	9	10	11	12
2	-	-	-	0.18	-	0.40	0.40	-	-	-	-	-
3	0.61	-	0.54	0.74	0.71	0.67	0.65	1.36	0.82	0.74	0.61	0.85
4	0.81	0.65	0.83	0.87	0.88	0.87	0.84	1.61	0.98	1.07	0.96	0.93
5	1.13	1.05	1.11	1.11	1.02	1.10	1.09	1.85	1.31	1.38	1.22	1.17
6	1.22	1.15	1.37	1.30	1.16	1.25	1.19	1.99	1.62	1.61	1.51	1.25
7	1.45	1.24	1.55	1.45	1.27	1.35	1.35	2.23	1.93	2.01	1.67	1.27
8	1.59	1.41	1.66	1.75	1.46	1.72	1.46	2.30	2.10	2.24	1.95	1.49
9	1.81	1.78	2.07	1.91	1.52	2.02	1.77	2.53	2.24	2.51	2.24	1.50
10	2.05	1.72	2.33	2.82	1.74	2.20	2.40	3.76	3.42	4.09	2.36	1.47
11	7.51	14.66	-	-	2.73	3.06	7.18	8.90	3.89	5.07	5.02	2.29
12	6.99	9.42	-	3.95	2.60	10.76	4.69	8.62	6.50	8.21	-	2.29
13	9.25	3.04	-	-	-	-	-	14.66	-	9.42	-	-
14	11.64	-	-	-	10.34	9.77	-	-	-	11.38	-	-
15	11.48	-	-	-	-	20.07	10.34	-	-	14.61	-	-
16	-	-	15.91	-	-	13.87	10.34	-	-	9.12	-	-
AVERAGE WEIGHT	1.41	1.25	1.30	1.22	1.24	1.25	1.15	2.19	1.68	1.99	1.45	1.29